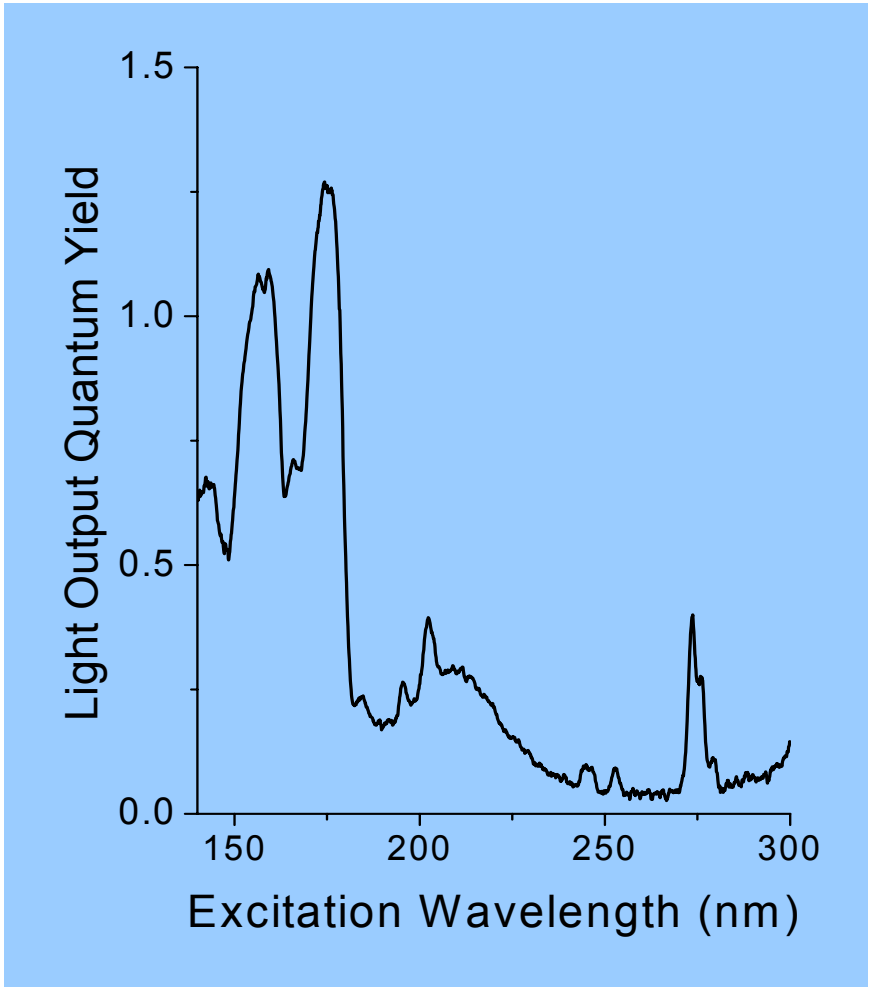
Quantum Cutting Phosphors (DMR-0305400)

Professor Richard S. Meltzer
University of Georgia

Energy usage for lighting comprises a significant fraction of the energy budget. Improvement of existing efficient fluorescent lamps would include elimination of polluting mercury and an increase in the present 33% wall plug efficiency. Lamps can be designed with a xenon discharge replacing mercury but this will require a new generation of phosphors that produce two quanta (photons) of light for each deep ultraviolet photon absorbed from the xenon discharge. As can be seen in the figure, we have recently obtained a phosphor which produces about 1.3 photons for each exciting photon demonstrating the feasibility of the quantum cutting concept. While the light thus far generated is too far in the red, it should be possible to design similar phosphors with the desired color output and further increase the energy efficiency.



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Education:

One Ph.D. student (Yi Zhou) and two visiting scholars, Professor Weija Jia (University of Puerto Rico at Mayaguez) and Dr. Sergey Feofilov, (Ioffe Institute in St. Petersburg, Russia), have been involved with this project. This research provides an opportunity for the student to gain expertise in phosphor development and to acquire the fundamental concepts in the optical properties of solids, especially those of rare earth doped insulators which form the basis for many phosphors. The training includes the gamut of techniques involved in vacuum ultraviolet (VUV) spectroscopy. Mr. Zhou and Dr. Feofilov are shown operating the VUV system. Close cooperation in this project with scientists at Osram Sylvania allow students to understand the interfacing of research and development in an industrial setting. Collaborating with us is Professor Keszler's group at Oregon State University which designs and produces the phosphors used in this effort. Students at the two Universities observe the synergy necessary to develop new materials.